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CONTENTS

INTERNATIONAL ACTION ON UNITS IN ELECTRICITY AND LIGHT

The Advisory Committee on Electricity and Photometry, established by the International Committee on Weights and Measures, held its third biennial meeting at Paris, January 31 to February 3. The committee consists of representatives of France, Germany, Great Britain, Italy, Japan, the United States, and the U. S. S. R. (Russia). All except the Russian representative attended this meeting. Specially invited experts from Holland were also present, as well as representatives of the International Bureau of Weights and Measures and of the International Commission on Illumination.

As was stated in Technical News Bulletin No. 190 (February, 1933), the principal purpose of this meeting was to fix dates on which new units in electricity and light might be internationally accepted for general use, and to make a definite plan for the comparisons and interchange of standards which will be necessary to assure uniformity of values among the different countries.

The conclusions reached are subject to ratification by the International Committee on Weights and Measures, and on some matters of principle it is considered necessary to obtain also the approval of the general conference of 32 nations, which is the ultimate authority. Both of these bodies meet in the fall of 1933.

The authority of the international committee to take up photometry under the terms of the existing treaty has been questioned, and the appointment of a single advisory committee to deal with this subject as an adjunct of electricity has been criticized. Consequently it is proposed to ask the general conference to authorize the appointment of a separate advisory committee on photometry. In the meantime, however, the present committee has collaborated with a special committee on units and standards appointed by the International Commission on Illumination, and consisting of representatives from the national committees on illumination in France, Germany, Great Britain, Holland, Japan, and the United States. With the advice of this group of specialists, considerable progress was made at

this meeting toward agreement upon a uniform international system of photometry.

The formal recommendations to be submitted to the International Committee on Weights and Measures, translated from the official French text, are as follows:

A. Electrical Units and Standards.

1. (*a*) The advisory committee confirms the opinion that the absolute system of electrical units should be definitively substituted for the present international system and believes that the International Committee should ask the General Conference on Weights and Measures to approve the principle of this substitution.

(*b*) Since some of the national laboratories have not yet completed the measurements needed to connect the international units with the absolute units, the advisory committee proposes to postpone until the year 1935 the provisional establishment of the ratio between each international unit and the corresponding absolute unit.

(*c*) It expresses the wish that at that date the international committee shall have obtained from the general conference the necessary powers to fix these ratios, as well as the date of adoption of the new units, without awaiting another conference.

2. (*a*) Although it may not be possible at present to attain a precision better than a part in 100,000 in the absolute determinations, the advisory committee believes that for the practical use of laboratories of precision there is reason to assign to standards of resistance and of electromotive force values expressed to a part in 1,000,000.

(*b*) The advisory committee requests the laboratories represented in its membership to appoint members of a technical subcommittee to make comparisons of resistance standards and standard cells with such precision as is necessary and to fix their values in absolute units. The president of the advisory committee is requested to assume the presidency of the subcommittee or to designate a member to act in that capacity.

(*c*) The advisory committee proposes that the technical subcommittee shall meet at the International Bureau of Weights and Measures during the year 1935.

(*d*) The advisory committee requests each laboratory to send for the comparisons at least 3 resistance standards and at least 10 standard cells, accompanied by a record showing the successive values which have been found for each standard since its construction. It will be desirable for those laboratories which have completed absolute determinations, to send a larger number of standards indicating their values as determined by the absolute measurements.

(*e*) In fixing the values to be assigned to the standards, the subcommittee shall choose the most probable value, after discussing the precision obtained by different methods in the several determinations.

(*f*) The subcommittee shall assign a value for each resistance standard and each standard cell included in the comparisons.

(*g*) Every proposal of the technical subcommittee shall be subject to the approval of the advisory committee before being presented to the International Committee on Weights and Measures.

3. The advisory committee having considered the observations of Professor Cohen (of Utrecht) on the metastability shown at temperatures below 12° C. by standard cells with 12.5 per cent of cadmium in the amalgam, while a 10 per cent amalgam does not present this undesirable characteristic, does not feel that it is necessary now to modify the specifications given by the London conference of 1908, but brings this circumstance to the attention of the different laboratories concerned so that they may take account of it in the future construction of cells.

B. Photometry.

1. (*a*) The advisory committee, while maintaining the opinion expressed in 1930 that the primary unit of luminous intensity should be based upon the radiation of the black body, believes that it would be premature at the present time to give specifications for such a standard.

(*b*) Nevertheless, it believes that the necessity of connecting the chosen primary standard with the units now in use will require fixing the brightness of a black-body radiator operating at a temperature near to the color-temperature of the carbon-filament lamps now used to preserve the unit of intensity.

(*c*) The committee proposes to choose for this purpose the temperature of solidification of platinum and it invites all the national laboratories which have not yet determined the brightness of the black body at this temperature to do so before 1935.

(*d*) It expresses the desire that the international committee seek from the General Conference on Weights and Measures the power to fix at a suitable time the brightness of the black body at the temperature of solidification of platinum and the specifications to be followed in the realization of a black-body standard of light.

2. (*a*) The committee believes that the problem of heterochromatic photometry can be solved only by fixing à priori a curve of factors of visibility. It suggests that the International Committee on Weights and Measures adopt the factors of visibility proposed by Gibson and Tyndall and approved by the International Commission on Illumination at its 1924 session.

(*b*) These factors are as follows:

Values of relative visibility

(Unity at wave length of maximum visibility)

Wave length in millimicrons	Relative visibility	Wave length in millimicrons	Relative visibility
400	0.0004	600	0.631
10	.0012	10	.503
20	.0040	20	.381
30	.0116	30	.265
40	.023	40	.175
450	.038	650	.107
60	.060	60	.061
70	.091	70	.032
80	.139	80	.017
90	.208	90	.0082
500	.323	700	.0041
10	.503	10	.0021
20	.710	20	.00105
30	.862	30	.00052
40	.954	40	.00025
550	.995	750	.00012
60	.995	60	.00006
70	.952		
80	.870		
90	.757		

(c) The advisory committee expresses the wish that the international committee shall fix the procedure for use of these factors with the counsel of the advisory committee and by agreement with the national laboratories and the International Commission on Illumination.

3. The advisory committee recommends that the national laboratories exchange lamps on which they shall have determined the ratio between the luminous flux and the intensity in a specified direction. Each laboratory should describe the methods used in determining this ratio.

The interchange of lamps in accordance with resolution 3 is expected to locate the cause of serious discrepancies which now exist between different countries in the measurement of total flux of light, without waiting for the settlement of the photometric difficulties arising from differences of color of light. The progress made toward solution of the latter problem is not fully reflected in the formal resolutions, because in fact agreement was reached informally on precise transmission factors for certain blue glass filters which will serve to connect measurements on modern lamps of high efficiency with the basic candlepower standards, giving a system of standard lamps in accordance with the visibility factors recommended in resolution 2.

ALCOHOL AS MOTOR FUEL

Ethyl or grain alcohol can be used as a substitute for gasoline in automobile engines, although such engines can not be started cold with alcohol alone in freezing weather.

When used in the same engine, gasoline and alcohol will deliver about the same maximum horsepower. Since alcohol contains less energy than gasoline, the engine, when suitably adjusted to give maximum horsepower with each fuel, will require about 1½ gallons of alcohol to equal 1 gallon of gasoline in total power output.

When alcohol is mixed or blended with gasoline, there is for each blend some temperature below which the mixture will separate into layers, the upper layer being mainly gasoline and the lower layer mostly alcohol. The smaller the proportion of alcohol in the blend and the greater the content of water in the alcohol used, the higher will be the temperature of separation. Thus, using commercial 95 per cent alcohol, mixtures containing less than 25 per cent of alcohol will separate at ordinary temperatures.

To make alcohol-gasoline blends containing less than 10 per cent of alcohol, it is necessary to use absolute alcohol or to add some blending agent, such as ether, acetone, aromatics, or higher alcohols. If such mixtures collect small amounts of moisture by leakage or "sweating" of tanks, they will separate into two layers with the alcohol at the bottom. Under these conditions, carburetor trouble would be experienced and starting might be impossible in cold weather. The development of more efficient blending agents may reduce the tendency of absorbed moisture to cause separation of alcohol-gasoline blends.

Blends of alcohol and gasoline containing less than 15 per cent of alcohol sometimes can be substituted for gasoline without readjustment of carburetors. These blends give leaner fuel-air mixtures than gasoline alone; hence if the carburetor is adjusted for an over-rich mixture, as is commonly the case, the alcohol blend substituted for gasoline may give equal fuel economy.

Alcohol is an antiknock fuel and alcohol-gasoline blends knock less readily than the same gasoline without the alcohol; therefore they can be used in high-compression engines. The addition of 15 per cent of alcohol to a gasoline will improve its knock rating about as much as the difference between the usual premium and nonpremium gasolines, or about 3 cents worth at retail prices.

Alcohol and fuels containing alcohol may be corrosive to some metals used in fuel tanks and fuel lines, although not sufficiently so to prevent the use of such fuels in cars as they are now made. New fuel systems designed for use with alcohol-gasoline blends should be made from metals not subject to this corrosion.

Ethyl alcohol can be made from grain, potatoes, molasses, or from various vegetable by-products. It can be made also from natural gas and from by-products of the distillation of petroleum or coal. To produce 1 gallon of alcohol requires about 25 pounds of either grain or molasses; hence the cost per gallon of alcohol from these sources can hardly be less than the cost of 25 pounds of grain or molasses. This permits a comparison between the cost of alcohol and gasoline.

In certain countries the cost per gallon of gasoline considerably exceeds that of alcohol. Under such conditions the use of alcohol-gasoline blends for fuel purposes is economically justified, provided the technical difficulties are satisfactorily met.

LUBRICATED GASOLINE

The bureau has had occasion to make engine tests of various dopes, including lubricants alleged to improve automobile engine performance, remove or prevent the formation of carbon deposits, lubricate the upper combustion chamber, and reduce wear and/or friction of valves. In no case has the treatment of gasoline with 1 per cent or less of such dope been found to have any significant effect, beneficial or otherwise, unless the dope affected the tendency of the fuel to knock or detonate. Anti-knock dopes have not been found to affect wear, friction, or carbon.

The rate at which carbon deposits accumulate in the engine cylinder depends on many operating factors and, therefore, extended tests under carefully controlled conditions are required to detect differences in this rate. Such tests usually have indicated that adding small amounts of lubricating oil to the fuel tends to increase the rate of carbon formation. Most of the products added to make "lubricated gasoline" appear to be mainly mineral oil, but some contain a small percentage of animal or vegetable oil or a small percentage of colloidal graphite.

Once an automobile engine has been run in, adequate lubrication of the cylinder wall should be accomplished from the crank case without necessity for adding a lubricant to the fuel. It is the function of piston and ring design to get the necessary lubricant where it is needed without admitting much oil to the combustion chamber. Conditions of inadequate cylinder-wall lubrication may arise where some benefit would result from the use of lubricated gasoline.

INFRA-RED RADIATION FROM AN ENGINE CYLINDER

Whenever a mixture of fuel and air is exploded in an engine cylinder a certain amount of energy is emitted in the form of radiation, part of this radiant energy being visible and defining what is referred to as the "flame." Observations of the manner in which the "flame" traverses an engine cylinder have been made at the bureau, using a specially designed head fitted with 31 symmetrically spaced windows (each giving a view perpendicular to the direction of flame travel) and a stroboscope arranged to give a view of the head once each engine cycle at a predetermined moment. In this way it has been possible to determine the position of the visible "flame" in the cylinder any time after the passage of the spark.

The greater part of the radiant energy from flames is, however, invisible and manifests itself in the infra-red region of the spectrum. In a paper to appear shortly in *Industrial and Engineering Chemistry* work on infra-red radiation from an engine cylinder is described.

Infra-red radiation is emitted whenever a substance is heated and varies with the temperature; moreover, the infra-red radiation from flames and explosions depends on the substances formed during the combustion, not on those burnt. For example, carbon dioxide and water vapor are formed in both acetylene and illuminating gas flames and can be detected by their characteristic emission bands in the infra-red region, just as other substances may be detected by their characteristic lines in the visible and ultra-violet regions.

Knowing the time of arrival of the "flame" under a given window in the engine head it is hoped, by measuring infra-red radiation through this window prior and subsequent to this moment, that some of the mysteries of combustion may be elucidated. In particular the time between the arrival of the flame under a selected window and the detection of carbon dioxide gives a measure of the so-called "reaction zone," while the differences in radiation from different parts of the cylinder, with and without fuel knock, may well throw light on the phenomenon of fuel knock in automobile engines.

THERMAL PROPERTIES OF CARBON DIOXIDE

Carbon dioxide is used extensively for refrigeration in theaters, ships, and other places where the life hazard in case of accident is relatively great. In the design and operation of refrigerating machines using carbon dioxide as the refrigerant it is important that certain physical properties of this substance be accurately known. One of the more important of these properties is the vapor pressure; that is, the pressure within a closed cylinder containing part liquid (or solid) and part vapor. This pressure increases very rapidly as the temperature is increased, and measurements must be made over a wide temperature range in order to obtain useful data.

Research Paper No. 538 in the March number of the Bureau of Standards Journal of Research describes measurements of the vapor pressure of carbon dioxide over the temperature range from —79° to +31° C. (—110° F. to +88° F.) At the lower temperature, the vapor pressure is approximately the same as atmospheric pressure and the material is solid. At about —57° C. (—70° F.) the solid melts, and the pressure is about 5 atmospheres (75 lbs./in.^{2}). This point where solid, liquid, and vapor coexist in equilibrium is called the triple point. Below this temperature only solid and vapor can coexist, and above it only liquid and vapor. Hence "dry ice" does not melt in the atmosphere, but merely evaporates. At a temperature of +31° C. 138° F.), the vapor pressure has increased to 73 atmospheres, and at this point, called the critical, the liquid and vapor become indistinguishable, so that a closed container is completely full of a homogeneous fluid.

The results of the measurements are formulated in extensive tables giving the vapor pressures in various pressure units for each ° C and ° F. In addition, all available measurements below —79° C. (—110° F.) have been critically reviewed, and tables giving the pressure down to very low temperatures have been prepared.

THERMOELECTRIC PROPERTIES OF PLATINUM-RHODIUM ALLOYS

A study has been made at the bureau of the thermoelectric properties of the platinum-rhodium series of alloys. Eleven members of the series were investigated from 0° to 1,200° C., the results being sufficient to yield the properties of any other member of the series by interpolation.

The properties of these metals are important because of their use in thermoelectric temperature measurements, and because it is customary to express the thermoelectric properties of other materials in terms of their relation to platinum. A complete account of this work will be published as Research Paper No. 537 in the March number of the Bureau of Standards Journal of Research.

DETERMINATION OF ALUMINUM IN NITRIDING STEELS

In the March number of the Bureau of Standards Journal of Research (Research Paper No. 533) a rapid method for the determination of aluminum in nitriding steels is described. The procedure consists in (1) separating aluminum from most of the iron by precipitating with sodium bicarbonate, (2) dissolving this precipitate in acid and precipitating the rest of the iron with sodium hydroxide, (3) treating the filtrate with 8-hydroxyquinoline to precipitate aluminum, and (4) either titrating with a standard solution of potassium bromate and potassium bromide after dissolving the aluminum quinolate in acid, or weighing the quinolate after drying at 135° C. The bicarbonate and sodium hydroxide precipitations, and the determination of aluminum by 8-hydroxyquinoline are discussed briefly.

MAGNETIC BALANCE FOR THE INSPECTION OF AUSTENITIC STEEL

In some of the more common types of corrosion-resistant steel the iron exists normally in the nonmagnetic or austenitic condition. Under some treatments the austenitic structure is partially broken down, the resistance to corrosion is decreased, and the magnetic permeability is increased. It has been found that the magnetic permeability is a good index of the resistance to corrosion. The ordinary test for permeability, however, which requires the preparation of samples of specified size and form, is not adapted to the testing of parts of a completed structure.

In Research Paper No. 523, published in the March number of the Bureau of Standards Journal of Research, a portable magnetic balance is described, which can be applied to various parts of a completed structure. Results obtained with an experimental model of the magnetic balance indicate that it should be of considerable practical value for the inspection of austenitic corrosion-resistant steel and other materials having similar magnetic characteristics.

EFFECT OF TEMPERATURE ON ELASTIC PROPERTIES OF METALS USED FOR AIRCRAFT INSTRUMENTS

One requirement of aircraft instruments is that their indications be independent of temperature in the range —50° to +50° C. Since the effect of temperature on instruments of correct mechanical design is due largely to the change in the elastic moduli with temperature of the elastic elements, data on this effect for materials of possible use in constructing elastic elements are of prime importance. The effect is most conveniently presented

as a coefficient which is the rate of change of the elastic modulus with temperature divided by the elastic modulus.

As an example, consider the indicator of air-speed meter of the pitot-static tube type. For a diaphragm of such an indicator, made of a material having a temperature coefficient of elasticity of -40×10^{-3} per °C., the change in reading in units of speed is computed to be $20\times10^{-3}\times80$, or 1.6 per cent for a change in temperature of 80° C. That is, at 100 m. p. h. the instrument will read 1.6 m. p. h. less if the temperature is reduced from, say, +45° to −35° C. This knowledge enables the performance to be specified to allow for this error, if the expense of compensation is to be avoided, and enables the manufacturer to separate the error from this cause from other possible temperature effects.

In Research Paper No. 531, to be published in the March number of the Bureau of Standards Journal of Research, experiments are described which were made at the bureau in cooperation with the National Advisory Committee for Aeronautics and which extend the work carried on by Brombacher and Melton, and published as N. A. C. A. Technical Report No. 538. In these earlier experiments only the temperature coefficient of the rigidity modulus was determined in the range −20° to +50° C. In the present experiments the temperature coefficients of the elastic moduli were determined in the temperature range −50° to +50° C. for 3 phosphor bronzes; 6 nickel silvers, Monel metal, duralumin, brass, beryllium bronze, tungsten; 7 high carbon steels; and 10 alloy steels. The materials were selected on the basis of their possible use as elastic elements for aircraft and other instruments. In most cases the coefficients were determined with the metal in the condition of heat treatment or cold work most suitable for its use as an elastic element and also in the annealed condition. The coefficient of each modulus at 0° C., the ratio of the coefficient at +25 to that at −25° C., the composition, and the heat-treated or cold-worked condition is given for each sample.

The method of experimentation differed from that usually followed and has many advantages. Two helical springs of a given material and the same design were coupled together and (*a*) stressed in tension to obtain the temperature coefficient of the rigidity modulus, and (*b*) stressed in twist to obtain the temperature coefficient of Young's modulus of elasticity. While under each type of stress the change in the deformation of the springs of the coupled system was measured as the temperature of one of the springs was varied while that of the other was maintained constant.

MEASUREMENT OF FLUCTUATION OF AIR SPEED IN TURBULENT FLOW

Further advances in the knowledge of the flow of air are dependent on the experimental determination of the character and magnitude of the fluctuations of the air speed about its mean value in turbulent air flow. The bureau, in cooperation with the National Advisory Committee for Aeronautics, has been active in the development of apparatus for making such measurements. The central element is a platinum wire about 0.015 mm in diameter and 7 mm long, which is heated electrically. Fluctuations of the speed of air flowing past the wire produce fluctuations of the temperature and hence of the electrical resistance of the wire. For small fluctuations of speed, the changes in resistance are small, and means must be provided for amplifying the small voltage fluctuations produced by the changes in resistance. Furthermore, even such a small wire does not correctly follow rapid fluctuations of air speed. A method of compensating for this defect of the hot wire anemometer was developed several years ago at the bureau. The method consists in the introduction of a special compensating circuit in the amplifier, which acts to give the combination of hot wire and amplifier a uniform response to fluctuations of a given magnitude over a wide range of frequencies.

Within the last two years numerous improvements have been made in the design of the amplifier and compensating circuit, and the performance of the equipment has been investigated, using a method developed by Ziegler. Technical Report No. 448 of the National Advisory Committee for Aeronautics, which has just been published, describes these improvements, the requirements and methods of design of amplifiers and compensating circuits, and gives the performance data of the equipment now in use at the Bureau of Standards. Frequencies from 25 to several thousand cycles per second are correctly reproduced.

CHANGE IN SCHEDULE OF RADIO TRANSMISSIONS OF STANDARD FREQUENCY

The bureau transmits standard frequencies from its station WWV, Beltsville, Md., every Tuesday. The transmissions are on 5,000 kilocycles per second. Beginning April 1, the schedule will be changed. The transmissions will be given continuously from 12 noon to 2 p. m. and from 10 p. m. to midnight, eastern standard time. (From October to March the schedule was from 10 a. m. to 12 noon, and from 8 to 10 p. m.) The service may be used by transmitting stations in adjusting their transmitters to exact frequency, and by the public in calibrating frequency standards, and transmitting and receiving apparatus. The transmissions can be heard and utilized by stations equipped for continuous-wave reception throughout the United States, although not with certainty in some places. The accuracy of the frequency is at all times better than 1 cycle per second (1 in 5,000,000).

From the 5,000 kilocycles any frequency may be checked by the method of harmonics. Information on how to receive and utilize the signals is given in a pamphlet obtainable on request addressed to Bureau of Standards, Washington, D. C.

The transmissions consist mainly of continuous, unkeyed carrier frequency, giving a continuous whistle in the phones when received with an oscillating receiving set. For the first 5 minutes the general call (CQ de WWV) and announcement of the frequency are transmitted. The frequency and the call letters of the station (WWV) are given every 10 minutes thereafter.

Supplementary experimental transmissions are made at other times. Some of these are made at higher frequencies and some with modulated waves, probably modulated at 10 kilocycles. Information regarding proposed supplementary transmission is given by radio during the regular transmissions.

The bureau desires to receive reports on the transmissions, especially because radio-transmission phenomena change with the season of the year. The data desired are approximate field intensity, fading characteristics, and the suitability of the transmissions for frequency measurements. It is suggested that in reporting on intensities, the following designations be used where field intensity measurement apparatus is not used: (1) hardly perceptible, unreadable; (2) weak, readable now and then; (3) fairly good, readable with difficulty; (4) good, readable; and (5) very good, perfectly readable. A statement as to whether fading is present or not is desired, and if so, its characteristics, such as time between peaks of signal intensity. Statements as to type of receiving set and type of antenna used are also desired. The bureau would also appreciate reports on the use of the transmissions for purposes of frequency measurement or control.

All reports and letters regarding the transmissions should be addressed Bureau of Standards, Washington, D. C.

PROTECTION AGAINST LIGHTNING

A revised edition of the Code for Protection Against Lightning has been issued by this bureau as Handbook No. 17. An earlier edition of this code was published as Miscellaneous Publication No. 92, and a report of the national committee handling the subject, dealing with the protection of electrical lines and apparatus, was issued as Miscellaneous Publication No. 95. It is anticipated that eventually the latter topics will be included in the formal code which now covers protection of persons, buildings, and structures containing inflammable liquids and gases.

In the new publication, Parts I and II of the code have been revised. Part I deals with the protection of persons; Part II deals with the protection of buildings and miscellaneous property including flagpoles, water towers, smokestacks, aircraft, ships, trees, and livestock. The changes in these two parts are rather minor in nature but have been made to perfect further the code by the national committee which reviewed the subject last year. Handbook No. 17 includes also Part III of the code dealing with the protection of structures containing inflammable liquids and gases. This part of the code has not been revised at this time but is expected to undergo revision at some future date. It was approved by the American Standards Association as American tentative standard when first published. Parts I and II were approved as American standards in the first edition, and approval of the revised text is now pending before the Standards Council of the American Standards Association.

Copies of this publication may be obtained from the Superintendent of Doc-

uments, Government Printing Office, Washington, D. C., at 15 cents each.

DETERMINING THE TOTAL ACIDITY OF SOILS

Estimation of the total acidity of soils has recently been shown to have applications apart from practical agriculture and in their characterization. The corrosiveness of soils is to a certain extent indicated by their acidity, and acidity methods appear to have a possible application in the ceramic industry. Methods for estimating the total acidity, however, have not been entirely satisfactory. Since the reactive material in soils is colloidal in nature, a reaction such as neutralization takes place only on surfaces and in somewhat indefinite proportions. Neutralization of the insoluble soil acids instead of occurring instantaneously, as is the case in solutions, is complete only after a considerable time. The course of such a reaction is necessarily difficult to follow. By reason of their collodial nature, soils tend to induce further error in total acidity determinations by absorbing alkali in quantities in excess of that required for neutralization.

As the result of a recent study at the bureau it was found that three methods, when applied to a group of 46 diverse soils, gave results which were in substantial agreement. It was possible to estimate the acidity of the majority of the soils studied by a conventional method of titration with certain modifications. The quantity of base added was plotted against the pH values of the soil extracts and the point of inflection in the titration curve taken as the end point. The clear extracts obtained by the use of 0.05 *N* calcium hydroxide in the presence of a neutral salt solution made possible the use of the colorimetric method of determining the pH values. In estimating the acidity of highly absorptive organic soils to which the titration method could not be applied, the indirect method of Page and Williams was successfully employed. This method is based on the principle that the total quantity of absorbed hydrogen ions in a soil is equal to the difference between the total quantity of replaceable bases which a soil can absorb and the quantity of bases actually present in the soil. Although the absorptive capacities of certain soils for bases are more or less unlimited, the capacity for replaceable bases is a definite and reproducible quantity. By determining this quantity, it is possible to distinguish between the base required for neutralization of soil acidity and that absorbed by some other process.

A complete account of this work will be found in Research Paper No. 539, to be published in the March number of the Bureau of Standards Journal of Research.

OPTICALLY STABLE SUGAR SOLUTIONS FOR COLORIMETRIC ANALYSIS

The successful application of colorimetry in the sugar industry is dependent upon the development of a satisfactory technique for preparing sugar solutions having the proper degree of transparency. In Research Paper No. 536, which will appear in the March number of the Bureau of Standards Journal of Research, revisions of existing methods are described. The process of clarification has been shortened and the transparency of the solutions improved. These results have been accomplished by increasing the concentration of the dry substance or total solids, dissolving and filtering the sugar products hot, and developing the application of better filters. In addition, other details of manipulation have been improved.

COLORED WATERPROOF DRAWING INKS

The bureau has, at the request of a Government department, recently completed work on the preparation of a number of water-fast drawing inks which do not deteriorate on storage for a period of at least one year.

These inks consist of an aqueous 5 per cent shellac solution to which has been added a small quantity of phenol, borax, and a dye. The shellac used was not bleached but was freed from natural waxes and dirt. Of 92 dyes investigated, only 17 were found to be at all suitable for this purpose. Of the 17, only 7 were selected, each of which produces an ink of a different color.

Of several different methods of testing the fastness to water, the most satisfactory consists in marking strips of paper with the inks, covering them with moist filter papers, and placing the strip and filter paper between dry glass plates. Thus the "running" of the dye can easily be detected and comparisons made between different inks. Under this treatment the 7 selected dyes "bled" or "ran" very little if at all.

CONTROL OF ATMOSPHERIC HUMIDITY IN LITHOGRAPHIC PLANTS

By measuring the moisture content of several different types of lithographic papers at different successive relative humidities, the bureau has secured further information that may assist lithographers in overcoming some of their printing difficulties. Both the moisture content of lithographic papers and the rapidity with which the content varies play an important part in the printing operations. For obtaining close register of successive color prints, the moisture content of the paper must be kept as uniform as possible because even small variations in moisture cause too much expansion or contraction of the paper. For accurate printing, the paper is generally conditioned; that is, exposed to air of fixed humidity until the moisture in the paper is in equilibrium with that of the air. This equilibrium must be maintained as closely as possible throughout the successive prints, and sometimes reconditioning is necessary between prints. The rapidity with which this can be done is important because conditioning is an expensive operation, and because delays here may mean such troubles as idle presses, and delayed deliveries of printing jobs.

In the bureau's study it was found that the moisture contents of all of the papers increased at a practically uniform rate as the relative humidity of the surrounding air was increased from 33 to 65 per cent. The average increase in this range was approximately 0.7 per cent for each 10-point rise in relative humidity. Above 65 per cent, the moisture change was more rapid. The moisture content of a paper, when conditioned to equilibrium with the atmosphere of a given relative humidity, varies according to direction of approach; that is, whether the moisture content of a dry paper has been brought up to, or that of a moist paper down to, balance with the fixed condition. The average moisture contents at 45, 55, and 65 per cent relative humidities were 5.6, 6.2, and 6.9, respectively, when approached from below, and 6.4, 7.1, and 7.7 per cent when approached from above. This indicates that in conditioning paper, uniformity as regards direction of approach to a fixed atmospheric humidity is as important as control of humidity.

The rate of conditioning to equilibrium with a fixed condition of relative humidity was quite rapid for all papers studied regardless of the moisture content at the start. Specimens of the different types of papers, having moisture contents varying from approximately 4.7 to 8.2 per cent, all practically reached equilibrium with an atmosphere of 45 per cent relative humidity after 40 minutes exposure. This represents time under ideal laboratory conditions. In industrial conditioning, the time, of course, would vary with the kind of conditioning treatment employed. Also, more time would be required for harder and more compact papers, such as bonds and ledgers.

INFLUENCE OF SODIUM CHLORIDE AND MAGNESIUM SULPHATE ON THE HYDROLYSIS OF LEATHER BY SULPHURIC ACID

A study of the influence of the two salts, NaCl and $MgSO_4$, on the hydrolysis of leather by sulphuric acid solutions has been made at the bureau by digesting samples of leather containing 5 g of hide substance in 200 ml of the prepared solutions for a definite time at 60° C. The effects of varying the concentration of acid and salt, and the time were investigated. Under any given set of conditions within the range studied, the presence of salts in the acid solution resulted in less hydrolysis than was found with acid solutions alone. Magnesium sulphate was more effective in retarding hydrolysis than sodium chloride. Increasing the concentration of salt decreased the degree of hydrolysis. It was shown that the apparent influence of the salts was to lower the initial rate of hydrolysis.

COMBINATION OF SILK AND WOOL WITH POSITIVE AND NEGATIVE IONS

Quantitative determinations of the combination of proteins with ions are made by electrometric methods. Qualitative determinations are made by employing salts containing colored ions or ions which may form colored compounds on treatment with the proper reagents. Both methods have been used for the determination of the isoelectric point. The possibilities and limitations of such methods are discussed in a paper by Milton Harris, research associate representing the American Association of Textile Chemists and Colorists, which will appear in the April issue of the Bureau of Standards Journal of Research.

Wool, with an isoelectric point at pH 3.4, combines with negative ferrocyanide ion in solutions ranging in pH up to about 5.0 and with positive

nickel ion in solutions ranging in pH down to about 2.0. Similarily, silk, with an isoelectric point of pH 2.5, combines with ferrocyanide ion up to about 4.0 and with nickel ion down to about pH 1.8. Consequently, values for the isoelectric points obtained by determining the pH limits of the combinations of positive and negative ions with silk and wool do not necessarily represent the isoelectric points of these substances but indicate the point above or below which the fiber combines with a given ion. The mean of these limits may give an approximate value for the isoelectric point.

ACCELERATED AGING TEST FOR WATERPROOFED DUCK AND SIMILAR FABRICS

The value of a waterproofed duck or similar fabric depends not only upon its waterproofness when new but upon its continued proofness during use. An accelerated aging test designed to produce changes in the waterproofness of cloth similar to those which may occur in service has been developed. The test includes exposure to an inclosed carbon arc lamp to simulate light exposure, and subsequent treatment in a specially designed machine in which the sample is flexed, rubbed, and distorted, first while it is dry and then while it is wet The details of this aging test, and also of the waterproofness test which has been found satisfactory for duck and similar fabrics, are given in a paper by William C. Smith, research associate at the bureau representing the American Association of Textile Chemists and Colorists, published in the American Dyestuff Reporter, volume 22, pages 114–118, 1933. This paper includes a comparison of the waterproofness of 15 representative fabrics after the laboratory aging treatment and after exposure out of doors.

COLOR OF MANILA ROPE

A good rope must be not only good when new must also be reasonably durable in service. There is no known test method for estimating this durability, although the Navy is now attempting to develop one. To protect itself, therefore, the Government requires that the rope which it buys shall be made of certain specified grades of Manila fiber, on the basis of the trade's experience that the higher grades of fiber produce ropes of greater durability.

Manila fiber is graded in the Philippines by visual inspection and passes through many hands before the finished rope reaches the ultimate consumer. It would obviously be worth while to develop a test method which could be used to grade the fiber in a sample of rope, and which would be sufficiently mechanical to be used by persons other than the expert Philippine graders.

Since the interests of the Government and of the industry run parallel in this matter, the bureau was glad to accept a research associate from the Cordage Institute to develop such a test method. As a result of this work, which has been in progress for about a year, a quantitative method for the evaluation of the color of rope fiber has been established. Equipment for use in applying this method has become available commercially and several rope manufacturers are using it. During January the Federal specification for Manila rope was revised by the cordage committee, Federal Specifications Board, to provide for the use of the new method and the revised specification was submitted to the Federal Specifications Board for promulgation.

OHIO CLAYS

In the investigation of the characteristics of Ohio clays just being completed at the Columbus branch of the bureau, it was found in the case of shales and glacial clays that a rather uniform variation exists between the pyrometric cone equivalents of the clays and the sum of the mineral constituents, orthoclase, kaolinite, and quartz. The percentage of minerals present in the clays was determined by calculation from the chemical analysis. The P. C. E. was found to increase as the sum of the percentages of these minerals increased. Also there seems to be a tendency for the sum of the kaolinite and quartz percentages to increase as the percentage of orthoclase decreases, although not in the same ratio.

In the 18 clays examined in this respect the orthoclase varied from 8.6 to 21.7 per cent; the kaolinite from 9.1 to 45.6 per cent; and the quartz from 19.0 to 53.8 per cent. The sum of the percentages of these three minerals varies from 54.4 to 86.3 per cent, the remainder being largely lime, magnesium, and iron bearing minerals. The P. C. E. values vary from cone 3 to cone 14–15.

FEDERAL SPECIFICATIONS FOR FIRECLAY BRICK

Several important changes have been made in specification HH–B–671 for

fire-clay brick. The provisions in the revised specification HH–B–671a will become mandatory for all departments of the Federal Government in the purchase of firebrick not later than April 15, 1933.

The revised specification is different from the one it replaces as follows:

1. The number of classes of bricks has been reduced from six to four, and siliceous brick (over 65 per cent silica) is now included in class H–75. However, the requirements for the siliceous type of brick shall only apply when specified in invitations for bids.

2. The softening point or P. C. E. requirement of bricks in class SH–75 has been increased from 31 to 32.

3. The requirements of the quenching test for bricks of class SH–75 now specify 18 cycles without failure instead of 15.

4. Bricks for the thermal spalling test are placed in the door of the furnace so that only one end is reheated instead of the entire brick. The brick will be quenched in 2 inches of water instead of 4 inches as formerly. No changes were made in temperature of reheat or quenching.

5. When special shapes are furnished in excess of two thousand five hundred 9-inch equivalents, it will be necessary to include standard 9-inch brick of the same composition for the thermal spalling test.

STUDIES OF MASONRY CEMENTS—WORKABILITY

One section covered by the general investigation of masonry cements conducted by the cement section of the bureau is a study of the "workability" of masonry cement mortars. Various opinions have been advanced as to the properties included in such a term and there is no exact definition that can be mathematically expressed. However, the difficulty of defining such a property, that is not mathematically expressed but is intuitively recognized by experts, fortunately does not preclude the efforts of investigators in the laboratory from developing their own concepts.

Qualitatively, plasticity can be described as the inherent resistance of a body to shear. This idea has been used in measuring viscous and plastic masses. The McMichael viscosimeter was developed for the purpose of measuring this resistance in viscous masses. The principle is, briefly, to measure the torque on a disk submerged in the mass under study when the mass itself is rotated. Such an instrument offered a principle that appeared to eliminate within reasonable limits the objectionable feature of segregation of mixtures of solids and liquids because of its motion, but as is usually the case, it underwent many changes before becoming a satisfactory device for the specific problem at hand.

The machine now consists of a cup about 5 inches deep and 4 inches in diameter with 3 rows of 4 teeth each stepped up radially on the inside. A toothed paddle not unlike the paddles in the old time ice-cream freezer meshes with the teeth fastened to the cup. The paddle shaft is connected to a balance. The cup is filled with mortar and rotated at a constant speed. The rotational force is transmitted from the cup to the paddle through the mortar. The balance measures the force necessary to keep the paddle stationary—or it can be said that it measures a function of the shear.

One mortar mixture was used, viz, 1:3 by weight of standard sand. Water was added by 1 per cent increments (calculated by weight of dry materials). A fresh batch of mortar was used for each set of measurements. The cup was rotated at three different speeds, and these speeds were repeated three times on the same batch of mortar. The limits of the water content were the limits of the device; that is, when the mix was too dry, large lumps were thrown out of the cup, when too wet, the solids settled.

The data were plotted on semilogarithmic paper; the torque values on the ordinates and the percentage of mixing water on the abscissa. All the data produced straight lines with a negative slope. The following equation was derived:

$$\text{Log of torque} = \frac{\log(1{,}200) - \log(200)}{K_1\,(W_{max} - W_{min})}\,x + \frac{W_{min}}{K_2}$$

Torque values, maximum and minimum, respectively, of 1,200 and 200 approximated closely the dry and wet limits of the mortar.

W_{max}=maximum amount of water used in terms of percentage of dry materals.

W_{min}=minimum amount of water used in terms of percentage of dry materials.

x=the amount of water added in terms of percentage of dry materials anywhere between the maximum and minimum amounts.

K_1 and K_2 are constants.

This equation shows that different cements have different requirements of water to produce the limiting values of shear. The maximum and minimum values of the slope and intercept are, respectively, as follows: 2.63, 7.43, and 0.065, 3.65.

SYNTHESIS OF KAOLINITE AND DICKITE

An error occurs in this item on page 18 of Technical News Bulletin No. 190; February, 1933. The second paragraph, tenth line, should read: "$Al_2O_3.2SiO_2.2H_2O$ are 39.5 per cent,".

NEW LIST OF STANDARD SAMPLES

A new list of standard samples for use in chemical analyses has just been published by the bureau as Supplement to Circular No. 398. This replaces the former list known as Supplement to Circular No. 25.

The samples are listed by groups, such as irons and steels, ferro-alloys, sheet brass, bronzes, bearing metals, die-casting alloys, limestone, clays, glass sand, various kinds of glasses and ores; sugar, naphthalene, and benzoic acid for determining heats of combustion; cement for testing the fineness of sieves; and pure chemicals, such as sodium oxalate, arsenic trioxide, and acid potassium phthalate.

Directions are given for ordering and the methods of shipment to addresses in the United States and foreign countries are described.

Copies of this pamphlet are obtainable without charge from the Bureau of Standards, Washington, D. C.

NEW AND REVISED PUBLICATIONS ISSUED DURING FEBRUARY, 1933

Journal of Research[1]

Bureau of Standards Journal of Research, vol. 10, No. 2, February, 1933 (RP Nos. 522 to 530, inclusive). Price, 25 cents. Obtainable by subscription.

Research Papers[1]

(Reprints from Journal of Research)

RP501. Isolation of the three xylenes from an Oklahoma petroleum; J. D. White and F. W. Rose, jr. Price, 5 cents.

RP502. Characteristic equations of vacuum and gas-filled tungsten-filament lamps; L. E. Barbrow and J. F. Meyer. Price, 5 cents.

RP503. The calorimetric determinatios of the intrinsic energy of gases as a function of the pressure. Data on oxygen and its mixtures with carbon dioxide to 40 atmospheres at 28° C.; F. D. Rossini and M. Frandsen. Price, 5 cents.

RP504. Shear tests of reinforced brick masonry beams; D. E. Parsons, A. H. Stang, and J. W. McBurney. Price, 5 cents.

RP505. The measurement of low voltage X-ray intensities; L. S. Taylor and C. F. Stoneburner. Price, 5 cents.

RP506. A multi-range potentiometer and its application to the measurement of small temperature differences; H. B. Brooks and A. W. Spinks. Price, 5 cents.

RP507. The density of some soda-lime-silica glasses as a function of the composition; F. W. Glaze, J. C. Young, and A. N. Finn. Price, 5 cents.

RP508. Coiled filament resistance thermometers; C. H. Meyers. Price, 5 cents.

RP509. Deflection of cosmic rays by a magnetic field; L. F. Curtiss. Price, 5 cents.

RP512. White-metal bearing alloys: Mechanical properties at different temperatures and service tests; H. K. Herschman and J. L. Basil. Price, 5 cents.

RP514. The heat capacity, heat of sublimation, and heat of solution of phosphorus pentoxide; M. Frandsen. Price, 5 cents.

RP515. The interference method of measuring thermal expansion; G. F. Merritt. Price, 5 cents.

RP516. Effect of lathe cutting conditions on the hardness of carbon and alloy steels; T. G. Digges. Price, 5 cents.

RP517. Measurements of ultra-violet solar radiation in various localities; W. W. Coblentz, R. Stair, and J. M. Hogue. Price, 5 cents.

RP518. Effect of service temperature conditions on the electromotive force of unsaturated portable standard cells; J. H. Park. Price, 5 cents.

RP519. The Thomas recording gas calorimeter; R. S. Jessup. Price, 5 cents.

RP520. Compressive strength of steel columns incased in brick walls; A. L. Harris, A. H. Stang, and J. W. McBurney. Price, 5 cents.

[1] Send orders for publications under this heading only to the Superintendent of Documents, Government Printing Office, Washington, D. C. Subscription to Technical News Bulletin, 50 cents per year (United States and its possessions, Canada, Cuba, Mexico, Newfoundland, and Republic of Panama); other countries, 70 cents. Subscription to Journal of Research, $2.50 per year; other countries, $3.25. Subscription to Commercial Standards Monthly, $1 per year; other countries, $1.60.

Circulars [1]

Supplement to C398. Standard samples issued or in preparation (list). (Supersedes Supplement to C25.) Free on application to Bureau of Standards.

C400. Inks. (Supersedes C95.) Price, 10 cents.

Commercial Standards [1]

CS43–32. Grading of sulphonated (sulphated) oils saponifiable types. Price, 5 cents.

CS44–32. Apple wraps. Price, 5 cents.

Handbooks [1]

H17. Code for protection against lightning; Parts I, II, and III. (Supersedes H12, formerly M92.) Price, 15 cents.

Commercial Standards Monthly [1]

Commercial Standards Monthly, vol. 9, No. 8, February, 1933. Price, 10 cents. Obtainable by subscription.

Technical News Bulletin [1]

Technical News Bulletin No. 190, February, 1933. Price, 5 cents. Obtainable by subscription.

LETTER CIRCULARS

It is the intent of the bureau to distribute single copies of these mimeographed letter circulars on request only to those parties having a special interest in the individual letter circular. Economy necessitates limitation in the number of copies issued. It is not the intent to supply parties with a copy of each letter circular issued during the month. Letter circulars are necessarily of a temporary nature designed to answer numerous inquiries on a given subject. Requests should be addressed to the Bureau of Standards, Washington, D. C.

LC358. Color charts. (List and description of color charts issued or used by branches of the U. S. Government, also list and description of color charts used for general purposes.)

LC359. Sound absorption coefficients of the more common materials. (Supersedes LC344.)

LC360. Rerefining used crankcase oil.

[1] Send orders for publications under this heading only to the Superintendent of Documents, Government Printing Office, Washington, D. C. Subscription to Technical News Bulletin, 50 cents per year (United States and its possessions, Canada, Cuba, Mexico, Newfoundland, and Republic of Panama); other countries, 70 cents. Subscription to Journal of Research, $2.50 per year; other countries, $3.25. Subscription to Commercial Standards Monthly, $1 per year; other countries, $1.60.

OUTSIDE PUBLICATIONS [2]

Lloyd, M. G., How lightning produces thunder, United States Daily (Washington, D. C.), vol. 7, No. 281, p. 8; March 3, 1933.

Paffenbarger, G. C., Sweeney, W. T., and Isaacs, A., Wrought gold wire alloys: Physical properties and a specification, Journal, American Dental Association (Chicago, Ill.), vol. 19, p. 2061; December, 1932.

Sweeney, W. T., Cristobalite for dental investment, Journal American Dental Association (Chicago, Ill.), vol. 20, p. 108; January, 1933.

Judd, D. B.:

Sensibility to color-temperature change as a function of temperature, Journal, Optical Society of America (Ithaca, N. Y.), vol. 23, p. 7; January, 1933.

Saturation scale for yellow colors, Journal, Optical Society of America (Ithaca, N. Y.), vol. 23, p. 35; February, 1933.

Tyndall, E. P. T., Chromaticity sensibility to wave-length difference as a function of purity, Journal of Optical Society of America (Ithaca, N. Y.), vol. 23, p. 15; January, 1933.

Gardner, I. C., Turning spherical surfaces (Abstract of RP467), The Engineer (London, England), vol. 155, p. 14; January 6, 1933.

Coblentz, W. W., Report to the council on physical therapy on heliotherapy methods in some European sanitariums, Jour. American Medical Assn. (Chicago, Ill.), vol. 100, p. 410; February 11, 1933.

Hughes, E. E., Determination of soap and fatty acid in dry cleaning solutions, the National Dyer and Cleaner (New York, N. Y.), vol. 24, No. 2, p. 39; February, 1933.

Perry, J. H., and Smith, E. R., A method for interpolating data, based on Dühring's rule, Industrial and Engineering Chemistry (Washington, D. C.), vol. 25, p. 195; February, 1933.

Whittemore, H. L., Air conditioning of dwelling against summer heat, United States Daily (Washington, D. C.), vol. 7, No. 265, p. 8; February 8, 1933.

Smith, W. C., Waterproofed ducks and similar fabrics, American Dyestuff Reporter (New York, N. Y.), vol. 22, No. 4, p. 114; February 13, 1933.

[2] "Outside publications" are not for distribution or sale by the Government. Requests should be sent direct to publishers.

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